SOILS and SECURITY

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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Fertile soil is seldom more than 7 or 8 inches deep.

Soils and Security

By H. H. Bennett, *Chief, Soil Conservation Service*

VALUE OF SOIL

Of all the gifts of nature, none is more indispensable to man than soil. Lying over the rocky core of the earth at varying depths, this complex mixture of animal, vegetable, and mineral matter is one of the four prime requisites for life. Along with sunlight, air, and water, soil nourishes all plant life and supports all animal and human life. Without it, this planet of ours would be as barren as the moon.

Over the continents of the world, there is a wonderful variety of soils. Ranging in color from brick red to deep black and in texture from coarse sand to fine clay, this dead-looking stuff actually teems with life and activity. Tiny organisms—too small for the naked eye to see—are ceaselessly at work in the upper thin layer of earth, breaking down decayed plant materials and building up fertility. The activities of these organisms are so complicated that they are not yet fully understood even by the scientist. But we do know that it takes generations, even centuries, for the creation of a 1-inch layer of really productive topsoil, as nature builds topsoil. Furthermore, the amount of really productive surface soil in any given place is strictly limited—seldom more than 7 to 12 inches deep and often less than 5. Beneath this level of topsoil is a layer of relatively unproductive material which originally consisted of decayed rock—subsoil that takes long periods of mellowing and growth to become truly useful soil. In a very real sense, the human race has been subsisting for thousands of years on a mere shell of vital soil matter.

BEGINNINGS OF EROSION

Since the dawn of time, soils have been on the move. Rain and wind have scoured away almost constantly at the earth's surface and transported soil particles from place to place. In this way stream channels have been carved out, river deltas have been built up, and whole landscapes have been gradually transformed. But under a protective cover of grass, trees, or other thick-growing vegetation, the rate of soil removal has always been exceedingly slow—no faster, generally, than the normal rate of soil creation.

This favorable soil balance prevailing under natural conditions was disturbed almost from the moment when man first started to till the earth for food. Clearing away the wild growth and breaking the ground surface with crude implements, the primitive farmer unwittingly speeded up the rate of soil removal. But farming probably went on for centuries before soil erosion became a recognizable human problem. It was only when population pressures forced the cultivation of steep slopes or unstable soils that people began to realize dimly that the earth can rapidly waste away under the impact of rain and wind.

EROSION AND CONSERVATION IN FOREIGN LANDS

Generally the more civilized people took active steps to protect their fertile lands from the ravages of accelerated erosion. In the Near East and North Africa, where western agriculture had its beginnings, soil conservation was a well-established principle centuries before the birth of Christ. At great cost in human labor, the more farsighted people of these older lands built benchlike terraces of stone or earth and other structures that effectively held their steep hillsides for generations against the inroads of swiftly moving rain water and also conserved rainfall for irrigation purposes. Eventually, however, wars, raids, and forced migrations led to neglect of conservation and irrigation works. Erosion was given full sway and has been active ever since over these fields of the ancients. Soil from the cultivated fields was gradually washed and blown over the uninhabited cities, towns, and market places. In recent years all over the Near East and North Africa archeologists have been unearthing the remains of once-magnificent centers of population, digging them out from under the accumulated erosion debris of centuries. The tragically ironic fact is that the monuments and even the dwellings of these ancient peoples were ultimately buried by the very soil that once supported their culture and their lives.

In China, erosion through long ages has produced some of the most spectacular land damage in the world. Along the upper headwaters of the Yellow River, where virgin forests were hacked down in the dim past to make way for cultivation, there are now huge gullies—many of them more than 200 feet deep. The Yellow River itself carries an annual load of 2½ billion tons of soil to the sea. Time and again across the centuries accumulations of sediment have caused major shifts in the channel. Floods have been perhaps more frequent and more destructive than anywhere else on earth. One deluge which occurred in 1877 is reported to have killed more than a million people and driven a far larger number from their farms and homes.

On the other hand, China probably has the longest continuous conservation record of any civilized country. In northwest China as the soil

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began washing downhill ages ago the farmers built large embankments which gradually increased in height year by year. Eventually the whole landscape was converted into a series of giant steps which effectively held the soil, for a time even on the steepest slopes. This ancient principle of terracing is still being used in parts of China, especially on rice plantations, almost without modification.

The story of the rise and fall of the Roman Empire is well known in political and military terms, but in agricultural terms it still remains to be told. We do know that the Romans started out as an agricultural people and that they left important writings on the subject of husbandry. Apparently in the early days they treated their lands with great care and even cultivated across the slope to reduce the dangers of erosion. As time went on, however, the urge to conquest led to neglect of the land resources. With the conscription of manpower for the army and the concentration of energy on military activities, farming was entrusted more and more to the care of unskilled slaves. Gradually the land suffered a decline in productive power, and the once-mighty empire became an easy prey for the more vigorous barbarians from the north and the east. Just how large a part soil erosion played in the downfall of Rome, no one can say with accuracy. But it was undoubtedly one of the many deteriorating forces that produced the final result.

In western Europe, agriculture followed a somewhat different course. For reasons which had little original connection with soil conservation,

the early kings of French and Germanic lands long ago established practices that grew into traditions which have served through centuries to hold erosion effectively in check. In order to preserve the forests for wood supply and as hunting grounds, these rulers laid down drastic decrees governing the cutting of timber. In some cases, wanton slashing of forest stands was even punishable by death. As a result, crop production was generally confined to the more nearly level lands, and every effort was made to keep the soil continuously productive. Gradually the

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Some of the soil-saving terraces built by the ancient Incas of Peru are still in active use.

people of western Europe developed a deep and lasting attachment to their fields and learned—by a slow process of trial and error—to adjust their agricultural practice to the natural environment.

Meanwhile the old forest-protection laws have been maintained and even strengthened. Other laws governing the inheritance of agricultural holdings have helped to encourage a conservative, nonexploitive type of agriculture in Switzerland and Germany. And in comparatively recent years positive programs of land improvement and soil conservation have been launched in Denmark, Switzerland, Germany, Hungary, and Italy. Today, of all the thickly settled portions of the earth, western Europe has perhaps the most stable agriculture and the least soil erosion.

In the Western Hemisphere farming has a long and varied history. Although the Indians lived mainly by hunting and fishing, some of the

tribes settled down to an agricultural way of life centuries before Columbus. In parts of South America, Central America, and Mexico and in southwestern portions of what is now the United States they cultivated steep slopes and valley lands and built conservation works similar in design to those of the ancient Near East. In fact, the way these prehistoric American farmers adapted their agriculture to the natural conditions is one of the most remarkable achievements in the history of man's struggle for existence. Today in certain sections of Peru, Bolivia, Guatemala, New Mexico, and Arizona remnants of check dams, terraces, irrigation canals, and water-saving structures built more than a thousand years ago are still standing. Many of them are in remarkably good condition; some of the Inca or pre-Inca terraces of Peru are still in active use.

SOIL WASTE IN THE UNITED STATES

Under white men agriculture on the North American continent developed slowly at first, then with a terrific rush. For nearly 200 years after the first colonizations at Jamestown and Plymouth, settlement in that part of the present United States not comprising the Spanish-settled Southwest, was confined by rugged mountains and Indian opposition to a comparatively narrow strip along the Atlantic seaboard. To satisfy the growing demands of the Old World, a large amount of land, especially in the South, was cleared and planted to corn, cotton, tobacco, and rice. With nearly every heavy rain, soil was swept out of hillside fields, down the creeks, down toward the sea. By the time of the Revolution, erosion had taken such a heavy toll of many southern plantations that some of the leaders of the day were thoroughly aroused. Time and again in their writings and public utterances men like Washington and Jefferson pointed to the dangers of erosion and the necessity for its control. In fact many of these early statesmen took active steps to prevent soil washing on their own lands.

But this conservation fervor was short-lived. After the Revolution, with the passage of the Ordinance of 1787, establishing the Northwest Territory, and the granting of new land to veterans of the War, an outlet was provided. The pressure of growing population on the land was relieved by the opening of virgin territories beyond the Alleghenies. Once this westward migration was started, it moved forward at an ever-quickening pace. All through the first half of the nineteenth century, settlers poured into the Middle West. From the growing industrial centers of the Northeast, from the worn-out eroded farms of the Old South, and from the crowded centers of Europe men came to these midlands in search of new opportunity. Then in 1862, after decades of agitation, Congress passed the original Homestead Act, and soon thereafter the whole westward movement was enormously accelerated. With

plenty of free land available beyond the Mississippi River, the tide of settlement moved swiftly across the prairies and the plains—even up into the foothills of the Rocky Mountains. By 1890—slightly more than a hundred years after the Ohio Valley was first thrown open to settlement—most of the better grade of plowable land within our present borders was occupied.

Today, as we look back on the frontier period in this country, we marvel at the courage, hardihood, and almost unbounded energy of the pioneers. Never before in history was such a mighty civilization built in such a short time. But this result was achieved at an unprecedented cost in basic natural resources. Forests were slashed down and prairie grasses plowed up without regard for the adaptability of the land for safe long-time cultivation. Wildlife was ruthlessly slaughtered. Many rich deposits of minerals were swiftly exhausted. Seldom in the history of the world has there been such widespread waste.

SCOPE OF THE EROSION PROBLEM

From the vantage point of today, it seems as if the farmers of the United States have done everything possible to speed the impoverishment of their productive lands. Steep hillsides have been plowed—usually straight up and down the slope. Ranges and pastures have been overburdened with great herds of cattle and flocks of sheep. Fields have been planted to the same crop year after year. Grasslands have been ripped open and exposed to the sweep of the wind.

In 1934 the Soil Erosion Service—predecessor of the Soil Conservation Service—made a Nation-wide survey to determine the approximate extent of erosion by water and wind. The results of that survey were shocking even to those who had been studying erosion for years. In a country with a gross area of slightly less than 2 billion acres, it was found that 14 percent of the land—about 280 million acres—had been essentially ruined for any further immediate cultivation. This vast area, nearly eight times as large as the land surface of Wisconsin, was once covered for the most part with a fairly deep layer of fertile soil. But nowadays these lands are so badly cut up with gullies, so completely stripped of topsoil, or, in case of range land, so stripped of forage plants, that any attempt to use them profitably or efficiently is simply out of the question. They are gone, and nature will restore their former productivity only after centuries of weathering and mellowing under a protective cover of vegetation.

Over and above these ruined lands, the survey of 1934 revealed a far larger area where erosion is rapidly getting under way or where it has already made serious inroads. About 775 million acres of all types

of land fall in this broad category. These lands are not yet ruined; there is still life left in them. In fact, a considerable proportion of these millions of acres are producing good crops and showing few outward signs of decline. But in every State and every important farming section—among the rich and rolling hills of eastern Pennsylvania, on the young wheatlands of the Pacific Northwest, even in the sugarcane country of southern Louisiana—soil is steadily slipping away. All told, over a billion acres—more than half of all the land we have—have been affected in some degree.

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In the United States erosion has already ruined about 14 percent of the land surface.

What makes the problem especially serious is the tremendous speed at which our soil resources are going out. When we consider the country as a whole we find that most of our land has been under cultivation less than a hundred years; and there is a considerable acreage in the West that was not broken out of native sod until the present century. Yet in this remarkably short time—a mere tick of the clock over the span of centuries—we have lost 14 percent of all our land and put another 35 percent on the move, not by any natural catastrophe but simply by carelessness and outright abuse. As far as can be determined from historical records and study of what has happened to the land, the United States has wasted its precious soil resources faster than any other nation or race that ever attempted to practice agriculture on an extensive scale.

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There are several reasons for this alarming situation. In the first place, probably no other people was ever confronted with such a seemingly limitless supply of land as were the North American settlers. Before the gaze of the frontiersman good land stretched to the far horizon. And on beyond the horizon he knew there was more virgin land lying rich and available for cultivation. If the early American wore out a farm in the process of making a living, it was comparatively easy to move on to fresher fields and greener pastures. Under such conditions exploitation was part of the normal order of things, and conservation was almost an unknown concept.

Another cause of the unparalleled soil waste in this country can be found in the conformations of our land surface and the character of our climate. At least 75 percent of our cultivated area has a sufficient degree of slope to be classified as definitely erodible. And over much of our cropland area the problem is further complicated by the fact that rains frequently come in sharp, dashing showers—the type of storms known in many sections as "gully washers," and cloudbursts. Furthermore, in regions like the Great Plains, where the land is comparatively flat, droughts are common, and unprotected soil is subject to wind erosion.

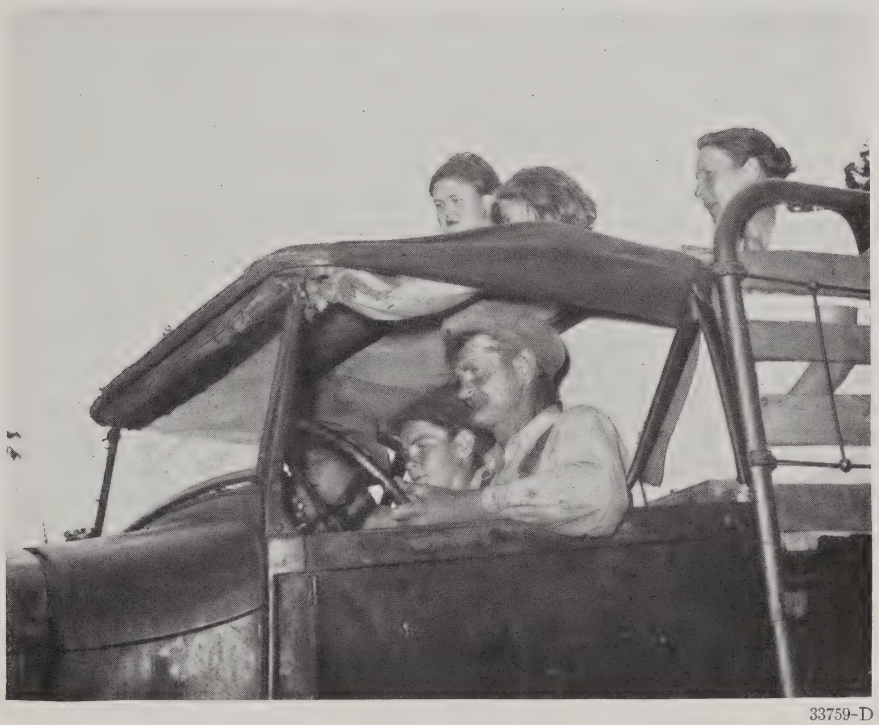
A third factor lying behind our many millions of eroding acres is the large amount of land we have in cultivation to intertilled crops. Europe—outside of Russia—has almost exactly the same total acreage in crops as the United States. But in the Old World countries, hay crops and pasture grasses that guard and nourish the soil are much more extensively grown. Altogether there are only 65 million acres in row crops in these countries, as compared with 155 million acres in the United States. In other words, this country, with the same area of cropland as western Europe, exposes two and a half times as many acres to the more serious forms of erosion.

EFFECTS OF EROSION

Whatever the reasons, it is clear that soil erosion is one of our most pressing national problems. Already it has ruined about 50 million acres of formerly cultivated land and reduced another 50 million to a definitely submarginal condition. As matters now stand, we no longer have too much good land left. Out of our present cropland area of 413 million acres, only about 351 million acres can be classed as really suitable for cultivation. The rest is too steep, too rough, or too infertile, or too susceptible to erosion and should be retired as soon as possible to a permanent cover of grass, trees, or some other protective vegetation. Furthermore, the greater part of our good-quality cropland is continually losing soil under prevailing methods of use. Actually we have now in

crops only about 62 million acres that are both good and definitely non-erodible. Pushed to the limit, we could—by undertaking costly projects of irrigation, drainage, and clearing—develop approximately 70 million acres of the same general type. But even this makes a total of only 130 million acres of really good, erosion-free land available for crops—less than 1 acre for every man, woman, and child and not enough to support our population at present living standards. In short, unless we adequately safeguard our area of good soil we may eventually face a serious land shortage.

Moreover, erosion is not just a threat to our future national security. Right now some 30 million people in this country depend directly on the land for a living. Every year thousands of them are driven to abandon their homes and take to the road in search of work and a new home. Every year other thousands slip a rung or two down the economic ladder as erosion gashes away the ground at their feet. As time goes on, it becomes increasingly apparent that the only alternative to a declining standard of living over large areas is better protection and better treatment for the millions of acres that are now subject to soil washing and soil blowing.



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Every year thousands of our farm people are driven to abandon their homes and take to the road in search of work. (*Courtesy Farm Security Administration.*)

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Eroded soil is filling our reservoirs.

COST OF EROSION

On the basis of the best information we have available, it appears that erosion is carrying off about 3 billion tons of our soil every year. Actually it is impossible to place any monetary value on productive soil for the simple reason that this resource is indispensable to human life. But these billions of tons that go coursing down our streams contain a vast quantity of plant-food material that can be valued, at least in an approximate way. At current fertilizer prices, the cost of the material that slips away from our farmers every year is worth millions of dollars. The value of the available plant nutrients—the raw material for bread, beef, milk, and garments—lost in this manner, together with lowered crop yields, probably amounts to a direct annual cost to the farmers of the United States of not less than $400,000,000. If we include potential plant foods—all the materials that eventually will help to nourish our crops—the loss rises to the staggering total of more than a billion dollars a year.

Of course, these losses fall most directly on the Nation's 30 million farm people, but the damaging effects of erosion really extend far beyond the farm. Eroded soil is filling up reservoirs—many of them at an alarm-

ing rate. It is getting into drainage ditches, irrigation ditches, navigable streams, and harbors. Altogether these troublesome deposits of the products of erosion are costing the country in the neighborhood of $92,000,000 a year. At the same time, erosion is increasing the costs of maintaining highways and railways by about $280,000,000 a year. It is making minor floods more frequent and major floods more destructive. It is cutting into our valuable wildlife populations and even reaching directly into cities in the form of silt deposits and stream-bank cutting. In one way or another—either through increased taxes, higher costs of living, or impoverishment of basic resources—erosion is hitting us all. And the total of the major items of damage is not less than $844,000,000 every year.

SILTING

The Soil Conservation Service has completed detailed studies of silt deposits in nearly a hundred representative reservoirs. About 500 additional reservoirs have been surveyed in less detail. Results of these investigations show that reservoir silting is a serious problem in almost every section of the country. There are now more than 8,400 dams and reservoirs in the United States, exclusive of farm ponds and some 2,000 reservoirs already completely filled. They represent a capital investment of not less than 2 billion dollars. At least one-fifth of this number, representing probably three-quarters of the total investment, depend solely on storage for their usefulness; when storage is gone as a result of filling with mud, their value will have largely or completely disappeared.

One of the most striking instances of rapid reservoir silting ever recorded by the Soil Conservation Service took place in Kansas. In April 1936 a stone dam was completed across the south fork of the Solomon River at a cost of $150,000. The dam was designed to create a reservoir with a maximum capacity of nearly 100 million gallons and was expected to provide the nearby city of Osborne with an ample supply of water. By September 1937—about 17 months after the date of completion—the storage basin was so completely filled with silt that the water was scarcely retarded in its flow.

Of course this Kansas reservoir is an extreme example of silting damage. Nevertheless, on the basis of surveys already completed, it has been found that a large proportion of the Nation's reservoirs are in danger of filling at some time in the near future. Unless present rates of sedimentation are reduced, 38 percent of existing reservoirs will have a useful life of 1 to 50 years; 24 percent, a life of 50 to 100 years; 21 percent, a life of 100 to 200 years; and only 17 percent a life of more than 200 years. In short, many of our reservoirs may be filled up before they are paid for. And once a reservoir is filled, there is no economical way to clean it out. We are thus losing not only reservoir capacity but also reservoir sites.

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Careless use of the land has severely aggravated the flood problem.

EROSION AND FLOODS

There have always been floods and always will be so long as heavy rains fall on the earth. They are a part of the natural order. But evidence piles up constantly to indicate that floods are growing more violent as the

land is cut into by erosion. In the United States under virgin conditions of forest and prairie, most streams ran much clearer than now. Occasionally they were muddied as the result of bank cutting. Some rivers receiving drainage from badland areas, where much of the land was bare of vegetation and eroding long before white men came to America, have always run muddy after heavy rains over these old eroded portions of the watersheds. But recent alluvial deposits along thousands of our streams tell the story of accelerated erosion and mounting floods. Mixtures of coarse and fine materials, lacking in uniformity, laid down since the beginning of agriculture, over fine-grained, uniform alluvium of the pre-agricultural stage tell the story. New soil types formed of new alluvium laid down over old deposits within historic time, now being mapped in soil surveys in various parts of the country, tell the story. Bench marks recording higher flood stages tell the story; history itself tells the story over and over of increasingly disastrous floods throughout much of the world.

When we examine the flood problem in detail we find that rains continue to fall over most of the United States much as they always have—coming sometimes in the form of gentle showers and again as violent cloudbursts. But the condition of the land is far different from what it was in early days. We have today in the United States on hillside fields and sloping ranges at least 200 million gullies. These gullies have been gouged into the face of the earth as a direct result of human occupation of the land, and they have profoundly affected our natural drainage system. During periods of prolonged or heavy rainfall, every one of these man-induced chasms—products of accelerated erosion—becomes an active waterway, concentrating run-off in a single channel and speeding it off the land to overtax drainage systems downstream. Billions of crop rows running up and down slopes have much the same effect. Millions of acres once clothed with mellow, absorptive topsoil have been stripped by gradual sheet erosion to a stiff subsoil layer that sheds water almost like a tin roof. Highway ditches, drainage canals, and other artificial waterways—all combine to lead rain water swiftly off the land. In short, we have, by the very act of building a civilization and by our careless use of the land, severely aggravated the flood problem of the United States.

EROSION AND WATER SUPPLIES

In the Great Plains country and farther west, where rainfall is light, farmers are finally coming to realize the value of storing up every available drop of water. In the eastern half of the country, where rainfall is more abundant, the problem of water conservation is less acute and less obvious, although it is of much greater importance than is commonly appreciated. Over large portions of the Southeast, as well as over most

other rolling parts of the humid region, crops often are poor and pastures thin, not because of insufficient rainfall but because too much of the available rain is permitted to run to waste. In other words, although the actual climate is unchanged, the effective agricultural climate or effective rainfall in terms of water at the plant roots has been tending in many areas, under this artificial acceleration of run-off, toward the equivalent of a very dry climate. When this tendency is combined—as it generally is—with a continuing loss of fertility through erosion, the farmer faces a serious prospect of steadily declining yields and steadily dropping income.

ECONOMIC CONSEQUENCES

On any given farm the effects of erosion are sometimes slow in appearing, depending on the physical characteristics of the land and the way the land is used. But sooner or later, crop yields begin to decline as the more productive top layers of soil are removed. At the same time, plowing frequently becomes a more difficult and more expensive job owing

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Farm people on severely eroded land are ill-fed, ill-clad, and ill-housed. (*Courtesy Farm Security Administration.*)

to the formation of gullies or the exposure of heavy subsoil resistant to tillage. Such soil-stripped land requires more fertilizer or manure and more rainfall in order to produce rewardingly. In short, as erosion advances, the whole job of farming becomes at once more difficult, more costly, and less profitable, and eventually it becomes impossible.

In terms of the individual farmer alone, this situation is bad enough. But when it is multiplied thousands of times across the United States, a problem develops which adversely affects the entire structure of the Nation's social and economic life. Almost without exception, farm people on severely eroded land are ill-fed, ill-clad, and ill-housed; they make poor risks for banks and lending companies, are poor customers for industry and business, and leave little that contributes to the general welfare of the country. As long as erosion continues to cut away land and impoverish farm people at the present rate, we can never hope to achieve a truly sound and lasting national prosperity in this country.

THE PROGRAM OF THE SOIL CONSERVATION SERVICE

During the 1930's the cumulative effects of continued land abuse in the United States took dramatic and tangible form. In the spring of 1934, for the first time since white men settled America, soil from the wheatfields of the midwestern part of the country was lifted into the high pathways of the winds and carried more than 2,000 miles eastward out over the Atlantic Ocean. From 1936 to 1938 exceptionally violent floods swept down some of the major rivers of the country, destroying farms, homes, and public improvements and taking human lives. Time and again through the 1930's drought struck in the semiarid sections of the country with devastating force. On all sides the people of the United States were brought sharply to the realization that their most vital resources—their land and their rainfall—were badly out of gear.

During this same period a wide-scale program of soil and water conservation was launched for the first time in United States history and pushed vigorously forward. Federal interest in the problem really began in 1929, when a number of experimental farms were established throughout the country to investigate the processes of erosion, to determine the rates of soil and water losses from different kinds of land used for various purposes, and to work out effective methods of control. Four years later—in 1933—soil conservation moved out of the laboratory onto the land. With the creation of the Soil Erosion Service, the Federal Government started lending direct assistance to farmers in soil and water conservation work. Then in 1935 erosion control became a definite national policy when the Soil Conservation Service was set up as a permanent agency in the Department of Agriculture by act of Congress;

and finally, during the latter years of the decade, the whole land-defense movement was given tremendous impetus by the passage of soil conservation districts laws in three-fourths of the States and by the financial assistance the Agricultural Adjustment Administration began giving farmers for soil conservation work.

The chief objective of the Soil Conservation Service is to promote control of soil erosion and better use of American farm and range lands over the widest possible area. So far, the Service has helped to establish complete soil- and water-conservation treatment on many thousands of farms and ranches comprising millions of acres of privately owned land. It has worked against a variety of backgrounds—all the way from the potato fields of Maine to the citrus groves of southern California—and it has encountered many complex and difficult problems of soil waste and rainfall waste. But none of these problems has proved completely incapable of solution; the accomplishments to date indicate clearly that American farmers can make their fields permanent and their lives and occupations more secure if they have the will, the ingenuity, the energy, and the necessary knowledge.

TECHNIQUES OF EROSION CONTROL

Not all the practices now being used to control erosion in the United States are really new. In fact some of them date back in one form or another to prehistoric times. But during the past few years most of these practices have been improved. Some entirely new practices have been developed by the Service. Now, for perhaps the first time, both the new and the improved practices are being used in effective combination on an extensive scale.

Since the beginning, the Soil Conservation Service has proceeded on the basis that erosion can be controlled adequately only if every acre on the farm, or within a watershed, is treated according to its needs and inherent adaptabilities. This means that cultivation is confined—as far as economically feasible—to the more nearly level parts of the farm. The steeper areas, the galled places, and the other erosion sore spots are kept in permanent pasture, meadow, or forest. In the end the conservation farmer has an arrangement of cultivated fields, pastures, meadows, woods, waterways, and stock ponds that fits the actual lay of the land, the climate, and the character of the soil and, as nearly as possible, the economic situation of that particular farm.

But this is only half the conservation program on the individual farm. Once the farmer seeking to control erosion has established a sound basic pattern of soil defense and land use, he applies specific treatments to every acre—again in accordance with the needs and adaptabilities of the land.

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Since 1933 the Federal Government has been lending direct assistance to farmers in soil and water conservation.

Croplands, for example, are nearly always farmed in rotation, usually on the level, and often in contour strips. Terraces are frequently built to provide further protection. Pastures are limed, fertilized, and contour-furrowed to improve the growth of grass. Gullies are sloped down, planted to permanent cover, and sometimes stabilized with small soil-holding dams. Woodlands are fenced, where necessary, to keep out livestock, protected from fire, and harvested so as to insure a constantly vigorous stand of timber. On range lands, conservation work takes a

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Conservation farming fits the lay of the land and the character of the soil.

somewhat different form. Where the original grass cover has been thinned out by overgrazing, the size of flocks and herds is cut down to a number the range can safely carry. Structures are built to store up the rainfall and spread it over the land where needed. And these are only a few of the dozens of practices now being employed. The specific kind of conservation treatment varies to meet the peculiar conditions. But always it consists of practical, workable methods that have been tried and proved practical in thousands of fields.

RESULTS OF CONSERVATION WORK

Over the past 6 or 7 years, conservation work of this kind has definitely proved its value time and again in many problem areas throughout the Nation. Almost without exception, the farms that have received full

treatment—a coordinated application of various adaptable control measures—for soil and water conservation are now losing much less soil and water than before. In a significantly large number of instances, the erosion problem has been eliminated almost entirely.

One of the most striking examples in the whole country is the work that has been accomplished in the watershed of Wilson Hollow near Temple, Tex. Here soil conservation plans were made without regard for county boundaries or even farm boundaries. The prime consideration was to

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On range areas, structures are built to spread water over the land.

protect the land as a whole—to lay out the controls along natural rather than artificial lines. During the past 5 years or so, farmers in this particular drainage area have worked in cooperation with Soil Conservation Service technicians—and in extremely close cooperation with each other—to establish measures for erosion control. Today these measures are effectively holding soil and water on 174 adjoining farms that cover 34,000 acres in a solid block—the largest contiguous area of conservation-treated farm land in the United States. Standing on a high point in the watershed, you can see in an unbroken pattern as far as the eye can reach fields and meadows and pastures that have been treated for conservation of soil and water. Terraces cross the boundaries of two, three, and even half a dozen farms. Strips of cotton wind along the contour across the slopes, and in between are erosion-control strips—strips of small grains,

sorghums, Hubam clover, and bluestem grasses. Every acre has been treated; all fields, pastures, and gullies—even roadside gullies—have been completely stabilized.

As a result of this work, erosion has been enormously reduced, rain water that had been running to waste has been directed into the body of the soil for plant use, the yield of lint cotton has gone up some 70 pounds an acre and that of corn 4½ bushels as compared with production on similar un-

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Near Temple, Tex., conservation treatment has been applied on 174 adjoining farms.

treated land on neighboring farms. Farmers there now feel that they can stay on the land and make a living.

Another case in point is a block of 112,000 acres of range land in central New Mexico where the grass was thinning out badly only a few years ago as the result of overgrazing. Since that time, a large amount of conservation work has been accomplished on this tract. Stockmen have adjusted the numbers of their cattle and sheep to the carrying capacity of the range, as determined by surveys of forage conditions on the range and the relation of vegetative cover to the erosion hazard. New fences have served to keep livestock out of sparsely vegetated areas until the grass has had an opportunity to recover; new watering places have helped to bring about a more uniform distribution of grazing. Contour furrowing and water spreading have played an important part in saving the rainfall and feeding it to the grass roots. As a result of all this work the grass on this tract of range land is now better than it has been for years, and the amount of soil washing has been sharply reduced.

Conservation farming has produced a variety of important benefits. While bringing erosion under control, thousands of farmers taking part in the Soil Conservation Service program have at the same time reorganized their whole farm enterprise on a more stable economic basis. Many who used to devote practically all their land and all their energies to the production of financially undependable cash crops such as cotton, wheat, or tobacco are now supplying more of their home needs from the products of their own acres. They are developing gardens, raising poultry and livestock, taking better care of their woods, and bringing idle lands into productive use. The net result of erosion-control and water-conservation work on farm after farm has been a better diversified, more self-sufficient, and more generally profitable type of agriculture.

In the Pecan Creek watershed, near Muskogee, Okla., the same type of work has produced another equally beneficial result. When this erosion-control project started back in 1936, 70 percent of the farmers were tenants, and 90 percent of these tenants had only 1-year leases. Over most of the valley, farmers were moving around from year to year without any feeling of security or any real regard for the welfare of the land. And soil was steadily slipping away—washing off the fields down into the creeks. Today the picture is sharply different. With 211 farms reorganized and stabilized along conservation lines, most of the landlords feel that the soil is there to stay; and most of the tenants are operating their farms under long-term arrangements. As a direct consequence of erosion-control operations, the whole relationship between landlord and tenant in this Oklahoma watershed has been greatly strengthened and improved. Both landlord and tenant have gained greater security, and both have learned to give consideration to the inseparable relation of

Tex-1462

Contour work is helping to produce more grass on the range.

the welfare of the land to the welfare of themselves and their community.

Even in the Dust Bowl of the southern Great Plains, where in recent years farm abandonment has become a truly critical problem, soil-defense work has helped to bring greater security for people on the land. In 10 typical counties of the southern Plains the Soil Conservation Service recently found that almost 1 farm in 6 had been abandoned in the past few years. Where the land had been treated for soil and water conservation, however, the ratio of farm abandonment was less than 1 in 30. And in 7 of the 10 erosion-control areas surveyed there was no abandonment whatever on the conservation-treated farms.

In summing up the results of soil conservation work to date, certain rather definite assertions can be made. First, erosion has already been controlled—for all practical purposes—on farms comprising about 20 million acres in private ownership. We have found a solution, or at least a partial solution, for every type of erosion that occurs on American agricultural land. And we have learned that the practices used to control erosion and conserve rainfall frequently produce important and far-reaching social and economic benefits over and above physical stability of the land. Moreover, flood heights have been markedly reduced along many small streams rising within areas where soil conservation work has been extensively carried on—the streams tend to flow for longer periods, and they carry less suspended soil downstream.

Despite all this encouraging progress, however, the country as a whole is not yet moving fast enough in the direction of conservation and better land use. Countless tons of fertile soil still go coursing down our rivers with every hard rain. Dust clouds still rise over the Plains whenever there is prolonged dry weather. Although defenses against rain and wind have been developed and tested, a vast area of farm and range land remains largely untouched by conservation work. Although we now know how to save our land, the real job of soil conservation in this country has only just begun.

Perhaps the most promising element in the whole situation is the recent rapid growth of soil conservation districts throughout the country. With the development of these districts, the whole soil conservation movement has taken on new power. Where the Federal and State Governments used to assume the lead, farmers themselves are now undertaking the primary responsibility for erosion-control and water-conservation work. In a very real sense the soil conservation districts are farmer cooperatives established for the purpose of soil defense. They embody the

Ga-253

For purposes of soil defense, farmers are now organizing soil conservation districts under State laws.

same spirit of community enterprise that is exemplified in the erosion-control demonstration area near Temple, Tex.

The original impetus for organizing a district comes from men who actually till the soil; it grows out of their needs and desires. Before a district can be seriously considered in any given locality, there must be a petition signed by at least 25 of the local farmers. Then hearings are held in the area, and all interested parties are given a chance to express themselves either for or against the idea of having a district. If the general tone of the hearing seems to be unfavorable or even lukewarm, the usual procedure is to drop the matter right there. And even if the hearing is completely enthusiastic, the district cannot be set up officially until it has been approved in a referendum by at least a majority vote.

Once a district has been organized, its affairs are managed by the farmers. The land operators within the district elect their own officers, make all the important decisions, and carry out most of the conservation work. As a general rule, however, they call on Government agencies to help them in analyzing their erosion problems and in applying the methods of control that involve more than the average technical skill. It is now the definite policy of the Soil Conservation Service to work toward its objectives by cooperating with these farmer-organized soil conservation districts to the greatest possible extent.

Figuring from the present rate of district formation and allowing for a certain amount of slacking up after the initial upsurge, it appears likely that by 1950 soil conservation districts in this country will cover about 367 million acres of farm and range land. If all these districts are properly organized and administered—if they receive a sufficient amount of help from State and Federal agencies—there is a distinct likelihood that during the next decade the forces of conservation will at least balance the forces of land disintegration over the country. And it is entirely possible that conservation may gain the upper hand during the coming 10 years.

While this action work is moving ahead out on the land, the need for effort along other lines is no less acute. There is need for a vast amount of research on many of the complex aspects of the problem—the economics and the sociology of land reform as well as the purely physical problems of readjustment. Likewise, there is need for continuing educational effort so that the gains made by action and research will not be lost as time goes on. People must be taught to think as a matter of course in terms of good land use if what we accomplish now is to be permanently effective.

It should be remembered that today's necessity for public action is the outgrowth of yesterday's failure to look more carefully to our land. Hindsight is easy; but foresight during the last century, when our present land use picture was in the making, would have produced a different

result. Today we are retracing our steps across this land in an effort to correct past mistakes in the interest of the future.

A new frontier has formed about us—one that must now be occupied by the forces of conservation. Fortunately we have learned how to achieve this defense of the land; we have the technical skill to do this job, and the labor. What is needed is the will to push ahead with the actual work on the land. We must remember that the longer we wait the more difficult and costly the job will be and also that defense of the soil is an inseparable part of national defense.

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